Feb. 10, 1925.

1,525,884

H. G. PLUMMER

CENTRIFUGAL PUMP

Filed Dec. 1, 1921

Fig. 2.

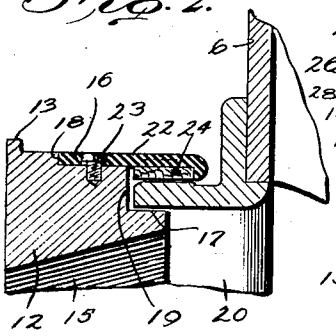


Fig. 1.

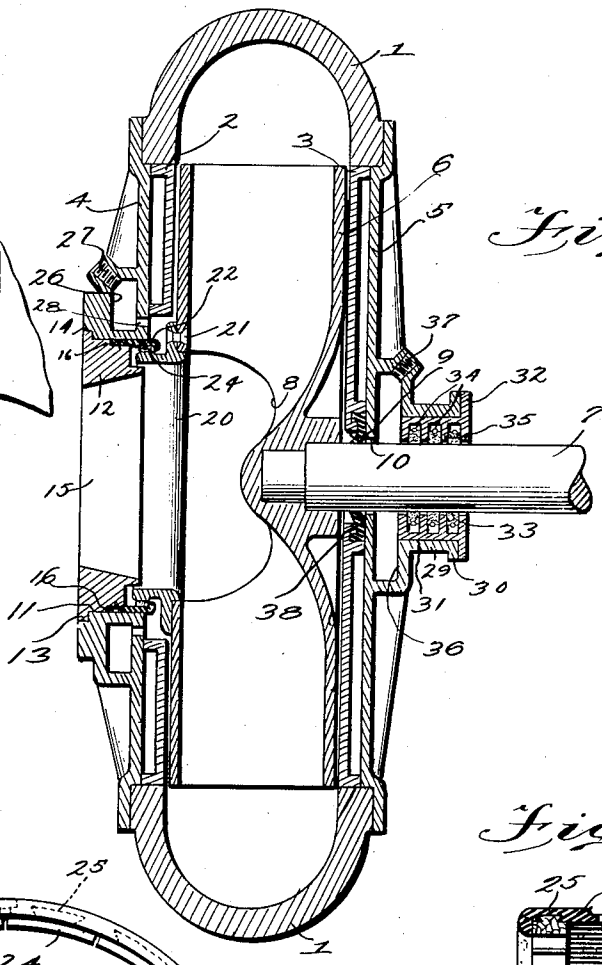


Fig. 3.

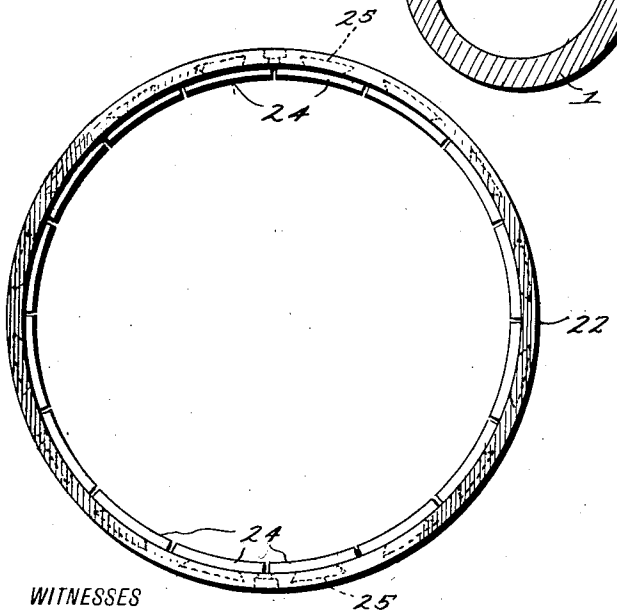
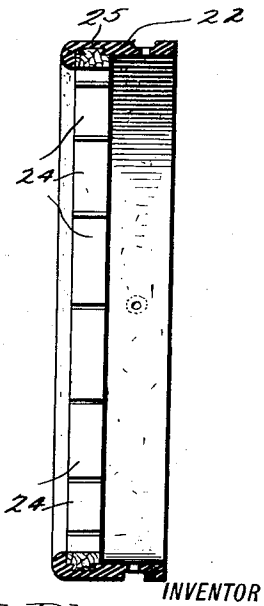


Fig. 4.



WITNESSES

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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL PUMP.

Application filed December 1, 1921. Serial No. 519,212.

To all whom it may concern:

Be it known that I, HENRY G. PLUMMER, a citizen of the United States, and a resident of Oakland, in the county of Alameda and State of California, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

My invention relates to improvements in centrifugal pumps, and it consists in the combination, construction and arrangements herein described and claimed.

An object of my invention is to provide in a centrifugal pump novel means for sealing the front or suction side of the pump and for preventing leakage between the impeller shaft and the adjacent parts of the pump.

A further object of my invention is to provide in a centrifugal pump, means for attaining the foregoing objects and being self-adjusting to compensate for wear on the relatively moving parts of the pump or for irregular movement of the moving parts of the pump.

A further object of my invention is to provide a centrifugal pump in which the wear on the relatively moving parts will be reduced to a minimum since means are provided for keeping these parts continuously lubricated and for preventing the passage of sand, clay, or other material of an erosive nature carried by the liquid entering the pump chamber between contiguous relatively moving parts of the pump.

Other objects and advantages will appear in the following specification, and the novel features of the invention will be outlined more particularly in the appended claims.

My invention is illustrated in the accompanying drawings, forming a part of this application, in which—

Figure 1 is a central vertical section through a pump embodying the invention,

Figure 2 is an enlarged sectional view of a fragmentary portion of the structure shown in Figure 1, illustrating to advantage the arrangement of the sealing ring embodied in the device with respect to a rotating cooperating ring carried by the pump impeller,

Figure 3 is an end view of the sealing ring embodied in the device, and

Figure 4 is a vertical section through the sealing ring.

In carrying out my invention, I make use of a centrifugal pump casing 1 which is of conventional form and is provided at opposite sides thereof with liners 2 and 3 and with sides 4 and 5, respectively. An impeller 6 mounted upon a shaft 7 is arranged for rotation within the pump casing, an annular space being provided between the outer ends of the impeller blades and the inner peripheral wall of the casing, which space communicates with an outlet port, not shown, for the pump casing.

The impeller 6 is fashioned to provide an intake or suction chamber, indicated at 8 in its side nearest to the side wall 4 and the shaft 7 extends through concentric central openings 9 and 10 in the liner 3 and the side 5, respectively. In consequence, I shall hereinafter refer to the side 4 as being the front or suction side of the pump and the side 5 as being the back or shaft side of the pump. It is well known that devices provided prior to my invention for sealing the front or suction side and the back or shaft side of a centrifugal pump of the type described so far have been unsatisfactory in service, particularly if the liquid drawn into the pump carries mud, sand, clay or other solid materials of an erosive nature. The ineffectiveness of the sealing arrangements provided prior to my invention is probably on account of the fact that the structural elements of such devices are not sufficiently self-adjusting to compensate for wear thereon or on the relatively moving parts of the pump, or for irregular movement of certain parts of the pump, as for instance of the impeller when the pump is out of balance. It has been found in service that the sealing means incorporated in a centrifugal pump embodying my invention produced satisfactory results under all conditions of the service for which it is intended and results in a saving of approximately 20% in the cost of operation.

The front or suction side 4 of the pump has a central opening 11 in which is disposed an annular throat ring 12. The throat ring 12 is preferably provided with an annular integral rib 13 at its outer end, which rib fits an annular recess 14 in the wall of the side 4 defining the opening 11. The throat ring 12 has a friction-tight fit with the side 4 and is thus held against rotation relatively to the latter. The inner wall 15

of the throat ring 12 defines an opening in which a suction pipe, not shown, is disposed in service and to which the suction pipe is joined in any suitable known manner. The outer peripheral wall of the throat ring 12 is reduced approximately midway of its length as indicated at 16 to provide an annular space between the inner wall of the side 4 and the outer wall of the throat ring 12 at the inner end of the latter, which space is enlarged by the further reduction of the outer peripheral wall of the throat ring 12 adjacent to its inner end, as indicated at 17, thereby defining annular shoulders 18 and 19, respectively, as best seen in Figure 2. A ring flange 20 secured to the impeller in any suitable manner as by means of rivets 21 projects in advance of the suction side of the impeller at the outer edge of the suction chamber 8 and extends into the annular space between the reduced portion 17 and the inner peripheral wall of the side 4 close to but not in contact with both the annular shoulder 19 and the portion 17 of the outer peripheral wall of the throat ring 12. The ring flange 20 is made of metal or other material having good wear resisting properties and rotates with the impeller 6 on account of its connection with the latter. A sealing ring 22 formed of any suitable material having inherent resiliency and elasticity such as rubber embraces the reduced portion 16 of the outer peripheral wall of the throat ring 12 and abuts the annular shoulder 18. The sealing ring 22 is maintained on the throat ring 12 and held against rotation relatively thereto by any suitable fastening means, such as cap bolts 23 having their heads counter-sunk and by reason of the fact that the sealing ring is stretched when placed in position on the throat ring. It is to be observed at this point that the sealing ring 22 extends beyond the annular shoulder 19 and overlies the end portion of the ring flange 20. The thickness of the sealing ring 22 is such that the portion thereof disposed between the throat ring 12 and the inner peripheral wall of the side 4 effectually seals the joint between the throat ring and the side and prevents the passage of a fluid between these parts. The portion of the sealing ring 22 overlying the ring flange 20 carries on the inner wall thereof a plurality of arcuate wear strips 24 which are arranged in spaced end to end relation and are attached to the sealing ring by a suitable means, such as the dovetail mortise and tenon arrangement indicated at 25. The rotating ring flange 20 is in sliding engagement with the wear strips 24 which are spaced sufficiently far apart to permit of constriction or expansion of the supporting portions of the sealing ring without precluding a sliding engagement of the ring flange with the wear strips. The wear strips 24 are preferably made of lignum vitæ but may be made of any other suitable material.

The side 4 is formed to provide an annular chamber 26 having an inlet port 27 screw threaded for connection with a supply pipe (not shown). The chamber 26 has an annular port 28 communicating with the interior chamber of the pump exteriorly of the projecting portion of the sealing ring 22 and adjacent thereto. The utility of the chamber 26 will presently appear.

When centrifugal pumps of the type of construction hereinbefore referred to get out of balance for any reason, there is a noticeable tendency of the impeller and the shaft to oscillate. The oscillation of the shaft displaces portions of the soft packing ordinarily used between the shaft and the adjacent parts of the pump and when such packing has set permanently in displaced condition dependency must be placed on the water seal resulting from the functioning of the pump to prevent the passage of air into the pump along the shaft or the leakage of liquid from the pump. When the liquid entering the pump carries erosive substances, such as clay, gravel, and the like, such parts work outwardly along the shaft and occasion undue wear on the relatively moving parts of the pump, as well as impairing the efficiency of the packing provided for the shaft. It is therefore important that means be provided for sealing the wall 5 around the shaft 7 while permitting free functional movement of the latter. To this end, the side 5 is provided with an integral cylindrical extension 29 terminating at its outer end in a flange 30. A stuffing box 31 has a friction tight fit with the cylindrical extension 29 and is fashioned with an outwardly extending flange 32 abutting the flange 30. Any suitable packing 33 of carbon, aluminum, or other material having a low friction coefficient, is arranged within the casing 31 in the form of a ring made up of a plurality of segmental sections encircled by contractile spring bands 34 and thereby continuously held in close engagement with the shaft 7. Integral lugs 35 extend inwardly from the inner wall of the casing 31 and engage with the packing 33 to hold the latter against rotation with the shaft 7. The side 5 is provided with an annular recess 36 in its peripheral wall which extends from the inner end of the cylindrical extension 29 and communicates with the inner chamber of the pump to the opening 10 which has heretofore been referred to as receiving the shaft 7. The annular recess 36 constitutes a chamber having a utility which will be described hereafter and an inlet port 37 therefor is screw threaded for connection with a supply pipe, not shown. A rubber gasket 38 is stretched and placed on the shaft 7. This gasket is

clamped at its outer edge between the liner 3 and the side 5 so that the hub portion of the gasket is displaced laterally of the position which it would naturally assume if unrestricted and is thus bent toward the interior of the pump.

From the foregoing description of the various parts of the device, the operation thereof may be readily understood. A liquid is drawn into the suction chamber 8 when the impeller is rotated to create a partial vacuum therein, as will be understood. It will be manifest that the suction on the sealing ring 22 will tend to maintain the wear strips 24 continuously in close engagement with the ring flange 20 carried by the impeller, thereby insuring an effective seal between the impeller and the front or suction side of the casing. A pressure fluid, preferably a liquid, is admitted to the annular chamber 26 through the inlet port 27 and passes therefrom through the outlet port 28 against the outer peripheral wall of the projecting portions of the sealing ring 22, thereby lubricating the wear strips 24 and aiding in maintaining the projecting portions of the sealing ring in close contact with the ring flange 20. The pressure fluid admitted through the port 27 into the annular chamber 26 and passing therefrom in the manner described will pass between the impeller and the side wall of the casing to mingle with the liquid between the outer wall of the impeller and the inner peripheral wall of the casing. The sealing ring 22 is thus held in operative position continuously with respect to the ring flange carried by the impeller both by pressure and by suction.

A liquid or other fluid under pressure is admitted to the chamber 36 at the shaft side of the pump through the port 37. This pressure fluid forces its way between the gasket 38 and the shaft to the interior of the pump casing and lubricates the gasket while providing a liquid seal at the shaft side of the pump. The packing 33 seals the extension 29 and prevents the pressure fluid from leaking between the shaft and the cylindrical extension 29, thereby preventing leakage between the side 5 and the shaft 7. In the event that the pressure within the pump should be built up sufficiently to overcome the pressure forcing the liquid admitted to the port 37 into the pump, the action of the pressure within on the gasket 38 will cause the latter to more closely embrace the shaft 7 and will prevent the passage of a liquid from within the pump through the opening 10 into the chamber 36. It will thus be apparent that an effective seal is provided at all times at the shaft side of a pump embodying my invention as well as at the suction side of the same pump. The impeller 6 and the shaft 7 may oscillate without in any way detrimentally affecting the operation of the sealing means provided by my invention.

I claim:—

1. In a centrifugal pump, cooperating continuously engaging sealing rings respectively carried by the suction side of the casing and by an impeller therein, one of said rings comprising an annular member made of a resilient elastic material and having an annular portion thereof free to expand and contract radially, and wear strips carried by the resilient elastic member in contact with the other sealing ring.

2. In a centrifugal pump having a casing and an impeller arranged for rotation therein, cooperating concentric sealing rings carried respectively by the casing and the impeller in position to continuously engage each other, the outer of said sealing rings comprising an annular member made of a resilient elastic material and having a flexible annular portion arranged to encircle a portion of the inner sealing ring, and a plurality of spaced wear resisting strips secured on the inner periphery of the flexible annular portion of the resilient elastic member in sliding contact with the inner sealing ring.

3. In a centrifugal pump, a casing provided with an inlet, an impeller arranged to rotate in the casing and cooperating concentric sealing rings arranged between said casing and said impeller to provide a seal for the suction side of the casing, one of said sealing rings being carried by said casing with a portion thereof in circumscribing relation to the inlet opening through the casing and with a flexible annular portion extending inwardly from the inlet, and the other of said sealing rings being carried by said impeller with a portion thereof disposed within the flexible portion of said first sealing ring, said first sealing ring comprising an annular member made of a resilient elastic material and a plurality of spaced wear strips secured on the inner periphery of the resilient elastic member in close sliding contact with the portion of the second sealing ring embraced thereby, and said second sealing ring being substantially rigid in construction.

4. In a centrifugal pump, a casing provided with an opening centrally positioned in one side thereof, an impeller arranged to rotate within the casing and provided with a suction chamber confronting the opening, a resilient elastic sealing ring partially disposed within the opening, a throat ring fitting within the opening for preventing displacement of the resilient elastic sealing ring therefrom and for joining a suction tube to the casing, said throat ring having its outer peripheral wall reduced at its inner end to provide a space between such reduced por-

tion and the inner portion of the said sealing ring, a metallic sealing ring carried by the impeller and arranged with the outer end thereof disposed between the reduced peripheral portion of the throat ring and the inner wall of the inner portion of the resilient elastic sealing ring, said metallic sealing ring being spaced from the reduced peripheral portion of the throat ring to permit slight oscillatory movement of the impeller, and spaced wear strips secured on the periphery of the resilient elastic sealing ring for engaging the metallic sealing ring.

5. In a centrifugal pump having a casing and an impeller rotating therein, said casing having a central circular opening located in front of the central portion of the impeller, a sealing member secured in said opening and having a cylindrical portion extending beyond the inner end of the opening into the casing in axial alinement with the impeller, said cylindrical portion being made of elastic material and being free to expand radially under stress, and an annular sealing member carried by the impeller to rotate with the latter about an axis alined with the axis of the impeller and for cooperating with the cylindrical portion of the first named sealing member to seal the space between said impeller and the wall of said opening in the casing, said second named sealing member having the outer end portion thereof extending into the cylindrical portion of the first sealing member and being adapted to rotate in the latter with the lapped portions of the two sealing members in fluid tight contact with each other.

6. In a centrifugal pump having a casing and an impeller rotating therein, said casing having a central circular opening located in front of the central portion of the impeller, a sealing member secured in said opening and having a cylindrical portion extending beyond the inner end of the opening into the casing in axial alinement with the impeller, said cylindrical portion being made of elastic material and being free to expand radially under stress, an annular sealing member carried by the impeller to rotate with the latter about an axis alined with the axis of the impeller and for cooperating with the cylindrical portion of the first named sealing member to seal the space between said impeller and the wall of said opening in the casing, said second named sealing member having the outer end portion thereof extending into the cylindrical portion of the first sealing member and being adapted to rotate in the latter with the lapped portions of the two sealing members in fluid tight contact with each other, said second named sealing member being made of a relatively stiff material.

HENRY GUION PLUMMER.